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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/649,425 | 08/27/2003 | James J. Chambers | TI35714 | 5169 |
| 23494 | 7590 | 10/20/2004 | EXAMINER | |
| TEXAS INSTRUMENTS INCORPORATED | | | SARKAR, ASOK K | |
| P O BOX 655474, M/S 3999 | | | ART UNIT | |
| DALLAS, TX 75265 | | | PAPER NUMBER | |
| | | | 2829 | |

DATE MAILED: 10/20/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|--------------------------------------|---|--|
| Office Action Summary | Application No. 10/649,425 | Applicant(s) CHAMBERS, JAMES J. | |
| | Examiner Asok K. Sarkar | Art Unit 2829 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 September 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 18-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-17 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 August 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date <u>8/27/2003</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Applicant's argument regarding the election of Group I and group II claims in the reply filed on September 20, 2004 is acknowledged and is found persuasive. Therefore, the group restriction requirement is vacated. However, the restriction requirement for the species is deemed proper since each species represents a separate invention as exemplified by the figures. Examining all species together will impose extra burden on the Examiner during searching.

The requirement is still deemed proper and is therefore made FINAL.

2. Claims 18 – 20 were withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected Species claims, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in the reply filed on September 20, 2004.

Claim Objections

3. Claims 7, 8 and 14 are objected to because of the following informalities: These claims should depend on claim 2 instead of claim 1. Appropriate correction is required.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States

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only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1, 2, 6, 9, 10 and 14 – 17 are rejected under 35 U.S.C. 102(e) as being anticipated by Buynoski, US 6,583,012.

Regarding claim 1, Buynoski teaches a method of forming dual work function metal gate electrodes in a semiconductor device comprising:

- forming a gate dielectric 27, 125 over a substrate 12, 202 with reference to Fig. 17 in column 11, lines 44 – 55;
- depositing a mold layer 22, 122 having a first opening 24, 124 therein over said gate dielectric with reference to Fig. 17 in column 11, lines 44 – 55; and
- creating a first metal gate electrode by depositing a first metal 206 in said first opening with reference to Fig. 18 in column 11, lines 63 – 65.

Regarding claim 2, Buynoski teaches creating a second metal gate electrode 212 over the substrate with reference to Fig. 22 in column 12, lines 16 – 60.

Regarding claim 6, Buynoski teaches the mold layer 22 consisting of inorganic material in column 3, lines 60 – 63.

Regarding claims 9 and 10, Buynoski teaches first metal is Ti, Mo and Pt in column 12, line 4.

Regarding claim 14, Buynoski teaches forming source and drain structures that are self-aligned with at least one of said first and second metals with respect to Fig. 22.

Regarding claims 15 – 17, Buynoski teaches an active device having a gate dielectric on a substrate and two metal gate electrodes with reference to Fig. 22. These claims are “product by process” claims.

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Note that a "product by process" claim is directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See also *In re Brown*, 173 USPQ 685; *In re Luck*, 177 USPQ 523; *In re Fessmann*, 180 USPQ 324; *In re Avery*, 186 USPQ 161; *In re Wertheim*, 191 USPQ 90 (209 USPQ 554 does not deal with this issue); *In re Marosi et al*, 218 USPQ 289; and particularly *In re Thorpe*, 227 USPQ 964, all of which make it clear that it is the patentability of the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. Note that applicant has the burden of proof in such cases, as the above case law makes clear.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

8. Claims 3, 7, 11, 12 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buynoski, US 6,583,012 in view of Takeuchi, US 2004/0080001.

Regarding claim 3, Buynoski fails to teach creating second metal gate electrode by forming a second opening in the mold layer and depositing a second metal in said second opening.

Takeuchi teaches forming a second opening 45B in the mold layer 23 and depositing a second metal 12 in said second opening with reference to Figs. 4B and 4C in paragraphs 99 and 100 for the benefit of lessening the depth of the counter doping impurity to be introduced in the vicinity of the substrate surface for forming the FET devices in paragraph 4.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to modify Buynoski and create second metal gate electrode by forming a second opening in the mold layer and depositing a second metal in said second opening for the benefit of lessening the depth of the counter doping impurity to be introduced in the vicinity of the substrate surface for forming the FET devices as taught by Takeuchi in paragraph 4.

Regarding claim 7, Takeuchi teaches removing the mold layer after depositing said first and second metal with reference to Fig. 6C in paragraph 117.

Regarding claims 11, 12 and 13, Takeuchi teaches removing the first and second metal located above said mold layer by CMP and etching with reference to Figs 3D, 4A, 4C and 4D in paragraphs 99 and 102.

9. Claims 4, 5 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buynoski, US 6,583,012 in view of Takeuchi, US 2004/0080001 as applied to claims 2 and 3 above, and further in view of Liang, US 6,130,123.

Regarding claims 4 and 5, Buynoski in view of Takeuchi fails to teach creating

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the second metal gate electrode that includes removing the mold layer and forming a second mold layer of a different composition from the first mold layer and having a second opening therein and depositing a second metal in said second opening.

Liang teaches that the simple method of depositing complementary metals one after the other will damage the thin gate dielectric during patterning in column 1, lines 60 – 64.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to modify Buynoski in view of Takeuchi and instead of forming the second gate of an alloy as taught by Buynoski, a second metal can still be deposited in the second opening keeping the integrity of the gate oxide during the patterning of the gate if a second mold layer of different composition is deposited (to alter the etching characteristic of the mold material) and an opening is made for depositing the second gate metal for the benefit of not damaging the gate oxide as taught by Liang in column 1, lines 60 – 64.

Regarding claim 8, Liang teaches first metal has a work function between about 4 and about 4.2 eV and the second metal has a work and between about 5 and about 5.2 eV in column 1, lines 24 – 33.

Conclusion

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Asok K. Sarkar whose telephone number is 571 272 1970. The examiner can normally be reached on Monday - Friday (8 AM- 5 PM).

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Tokar can be reached on 571 272 1812. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

11. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Asok Kumar Sarkar

Asok K. Sarkar
October 12, 2004

Patent Examiner